SATURDAY, FEBRUARY 16, 1935

No. 3407 Vol. 135

## CONTENTS


| | PAGE |
|---|---|
| Scientific Adventure and Social Progress | 245 |
| Isomerism and Tautomerism. By T. M. L. | 247 |
| Electron Physics. By H. L. B. | 249 |
| Dialectical Materialism. By S. | 249 |
| Problems of Crossing-Over. By R. R. G. | 250 |
| Short Notices | 251 |
| A Large French Wind Tunnel | 252 |
| Minute Intergenic Rearrangement as a Cause of Apparent 'Gene Mutation'. By H. J. Muller, A. Prokofyeva and D. Raffel | 253 |
| Obituary: | |
| Sir Horace Lamb, F.R.S. By G. I. T. | 255 |
| Dr. A. A. Belopolsky | 257 |
| Rev. T. E. Espin | 257 |
| News and Views | 258 |
| Letters to the Editor: | |
| Viscosity of Helium I and Helium II.—Prof. E. F. Burton | 265 |
| An Application of Infra-Red Photography to Palæobotanical Research.—Prof. John Walton | 265 |
| Scattering of Hard γ-Rays and Annihilation Radiation.—Dr. E. J. Williams | 266 |
| Colchicine and Tumour Growth.—Dr. E. C. Amoroso | 266 |
| Identity of Vitamin $B_2$ and Flavine and the Nomenclature of Vitamins.—Prof. B. C. P. Jansen | 267 |
| Aluminium Chloride as a Catalyst of Hydrogen Interchange.—J. Kenner, Prof. M. Polanyi and P. Szego | 267 |
| Crystal Structure of Cyanuric Triazide.—Dr. I. Ellie Knaggs | 268 |
| Spectra and Latent Energy in Flame Gases.—Dr. Sydney Steele | 268 |
| Diamagnetism of Light and Heavy Water.—Dr. Francis W. Gray and James H. Cruickshank | 268 |
| Spectrum of Doubly Ionised Iodine.—Prof. J. B. Seth | 269 |
| 'Viscacelle' as a Material for making Compensating Plates and Wedges for the Polarising Microscope.—Dr. N. H. Hartshorne | 269 |
| Dimensions of Electric and Magnetic Units.—Prof. L. R. Wilberforce | 270 |
| Structure of the Caudal Fin of the Cod.—E. J. W. Barrington | 270 |
| Evolution and Human Origins.—Sir Ambrose Fleming, F.R.S. | 271 |
| More Work for the R.S.P.C.A.—The Right Hon. Sir Herbert Maxwell, Bart., F.R.S. | 271 |
| Research Items | 272 |
| Chlorophyll | 275 |
| Fuel Research in Great Britain. By H. J. H. | 276 |
| University and Educational Intelligence | 277 |
| Science News a Century Ago | 277 |
| Societies and Academies | 278 |
| Forthcoming Events | 280 |
| Official Publications Received | 280 |


## Scientific Adventure and Social Progress

THE national lecture by Dr. T. R. Glover on the challenge of the Greek, broadcast on December 19, vividly recalls in its plea for the classical discipline one of the most suggestive passages in Prof. A. N. Whitehead's "Adventures of Ideas". In brief compass, Dr. Glover set forth the antithesis which Greek customs, ways of living and outlook on life present to those characteristic of this age, and suggested certain aspects of Greek life which are worthy of our consideration.

The five aspects discussed by Dr. Glover are so interrelated that an attempt to differentiate between them in order of importance is largely beside the mark. Few to-day, for example, whether interested principally in science, in art, in industry, in politics, or in society as a whole, would deny the fundamental importance of creative thought as the mainspring of constructive action, or that such thought is one of our most urgent needs. This pre-eminent characteristic of the Greeks cannot, however, be dissociated from their capacity to interpret life, to see life steadily and to see it whole, from their essential young-mindedness and adventurousness, their individuality and passion for self-expression, their freedom of enterprise.

The tragedy of the present day lies largely in the senility of mind with which, over whole ranges of industrial, social and political problems, we are confronting opportunities which are stupendous compared with those possessed by the Greeks. There is scarcely a field of human enterprise and thought, from the unemployment situation, disarmament and tariffs to transport or county planning, in which the powers and opportunities given into our hands by science are not being misused, abused or lost through lack of courage and magnanimity. Truly did the prophet exclaim: "where there is no vision the people perish".

This inelasticity of mind has two consequences. It limits or even excludes the experiments which younger and more adventurous minds would make, and it severely discourages the multiplication of youthful and independent types of leaders. While it becomes more and more difficult for youth to gain experience of leadership and to demonstrate its capacity, the growing standardisation of life to which Dr. Glover directs attention threatens to stifle such aspirations at the source. Russia seems intent on producing citizens of a single type: Italy and Germany equally appear to discourage individuality and independence of mind; a shrewd

observer suggests that in the United States the object of education is to turn the human mind into a card index; and education in Great Britain is characterised by much the same standardisation and conformity to type. The danger of the breakdown of civilisation through sheer inability to maintain the quality of administration and consequent social equilibrium foreshadowed by Brook Adams in his "Theory of Social Revolution" is apparent alike in the democratic State or under dictatorship.

The contrast between this standardisation and mechanisation of life to-day and the glowing vitality of the Greeks which Dr. Glover depicted so vividly is worth consideration. The challenge thrown down is fundamentally one of thought. If the adventurous, speculative mind, dynamic and eager for novelty, which the Greeks possessed, is one of the most essential factors for recovery of control over our specialised activities, the thrusting energy of our sectional and selfish interests, and to afford free access to everything in our rich heritage of civilisation which we have the capacity to enjoy, the most 'un-Greek' thing we can do, as Whitehead points out, is to copy the Greeks.

In the very suggestion of imitation or copying there is a hint as to our fundamental trouble. In an age of unprecedented change and technical advance, a tendency to take the Greek and Roman civilisation at its best as a standard, and to aim at reproducing the excellencies of these societies, is too static an ideal and neglects the whole range of opportunity. It is no longer sufficient to direct attention to the best that has been said and done in the ancient world. The result is static repression, and promotes a decadent habit of mind that can be traced in certain countries to-day.

Undue reliance upon the past for guidance and as a standard is a danger to any age. In this present age the peril is even more acute. The increasing *tempo* of technical development makes reliance on the wisdom of the past increasingly unsound. We are living in a period of human history when, probably for the first time, the assumption is false that each generation will live substantially amid the conditions governing the lives of its fathers, and will transmit those conditions to mould with equal force the lives of its children.

This fact alone would explain many of the difficulties in which we find ourselves, our persistent pursuit in economic and international affairs of mutually inconsistent policies. The shortened time-span of technological change increases the disturbance of social and economic life by the application of scientific discovery and in turn demands greater powers of adaptation and readiness to adopt new methods akin to those characteristic of the Greek. Our training must prepare the individual to face conditions for which the past is an imperfect guide. We require such an understanding of the present conditions as may give us some grasp of the novelty which is about to affect the immediate future.

We are here confronted with that divorce between wisdom and knowledge which is an untoward characteristic of many departments of political, industrial and social life. Despite known gaps in our knowledge of the social sciences, we have already vast stores of knowledge which could be utilised for the re-building of a social order capable of meeting the new conditions and making available for all the great resources with which now for the first time science has endowed mankind. Between that age of abundance for all, and the deprivations and distresses of the present time, stand the ideas inherited from a more static age in which available resources were incredibly smaller, and the routine in which those ideas have crystallised themselves. Routine, which should be the servant of society, is in a fair way to become its master.

It is fashionable at the present time to blame the machines for the mechanisation of life and the uniformity in working and in leisure hours imposed upon whole sections of the community. To do this is to make the fundamental mistake of regarding the machine as the master and not the servant of society, and to forget that the most regrettable results of industrialisation are for the most part not the direct fault of technology but of economic developments. As regards the technical and scientific aspects, in fact, our technical and industrial development was historically unavoidable. Mechanical power, as Mumford remarks in "Technics and Civilisation", is no new thing, but in earlier ages men had saner ideas of labour-saving devices, and the water mills of the first century B.C. were welcomed by Antipater of Thessalonica as a means of enjoying the fruits of Demeter without labour. The mechanisation of industrial and social life to-day is due essentially to our failure to understand the machine and to use it to serve and not to dominate the life of man. In our search for stability we have organised society to a point at which routine, upon which

civilisation is undoubtedly founded, becomes an obstacle to progress and adaptation to the new conditions.

The absence of foresight in itself explains the lack of leadership. Men seek security in the dull conformity to type. Despite the many elements of scientific and sociological discipline required in the modern business mind, there is little of that power of general thought, undaunted by novelty, which is the gift of philosophy in its widest sense. The absence of such a co-ordinating philosophy of life permeating the community spells decadence, boredom and the slackening of effort. The mere compulsion of tradition has lost its force, or even may urge us into dangerous paths. As Whitehead reminds us, our fundamental task is to re-create and re-enact a vision of the world, including these elements of reverence and order without which society lapses into riot, and penetrated through and through with unflinching rationality. That is the challenge of the Greeks to our age, and whether we rise to the greatness of our opportunities, exploiting its adventure and mastering the network of relations which constitutes the very being of this epoch, or whether we collapse before the perplexities confronting us, depends both on our courage and our intellectual grasp.

This challenge is unescapable. Advance or decadence are the only choices offered to mankind. Perfection is essentially dynamic and not static. Whether we are at present in a period of slow decline, or whether we are in a period of transition to a new form of civilisation involving in its dislocations a minimum of human misery, it would be rash to prophesy. There are regions of human endeavour in which creative thought is still sufficiently active to inspire the hope that it may infect the more sterile regions of politics and sociology, where originality and constructive thought are so sorely needed. The trend of discussions on the relation of science to social problems within the last two years justifies the belief that in this field thought has run ahead of realisation, and that only courage and vigour are required to secure the realisation of those dreams.

The challenge presented to us so vividly alike by Dr. Glover and Prof. Whitehead is one to which the scientific worker above all should respond. He is becoming increasingly conscious that, as the exploration of the physical world proceeds apace, the reaction of the new knowledge upon the social order, of which he himself forms a part, is opening up new fields of endeavour in which his method and impartial questioning spirit can find ample satisfaction. He will remember that the great ages of the past have, on the whole, been the unstable ages: the great achievements, the adventures of the past. He will look back in a spirit of adventure, understanding the past, and look forward in the same adventurous spirit which unlocks the secret of the past, to the wide fields as yet largely untrodden, within which science may yet render its greatest services to mankind and make the rich resources of Nature available for all in a new social order worthy alike of the prodigality of Nature and of man's own rich intellectual heritage.

## Reviews

### Isomerism and Tautomerism

*Tautomerism.* By Dr. J. W. Baker. (Twentieth-Century Chemistry Series.) Pp. viii+332. (London: George Routledge and Sons, Ltd., 1934.) 25*s.* net.

THE term 'tautomerism' was introduced by van Laar in 1885 in order to describe those cases in which the compounds represented by two different structural formulæ are found to be "not isomeric but identical". A pioneer example of this phenomenon was discovered in benzene, since Kekulé, so long ago as 1870, was content to regard the single and double bonds in his formula as merely an instantaneous picture of a moving system, in which the double and single bonds were incessantly changing places. In this way he was able to account for the fact that the 1 : 2 and 1 : 6 di-derivatives of benzene are, as Laar expresses it, "not isomeric but identical". Kekulé's migrating bonds would now be described as a flow of valency electrons, and the phenomenon would perhaps be described as *electromerism*, but his fundamental ideas are still valid. Indeed, at the present day, chemists would probably be unanimous in saying that *all* the diverse formulæ which have been assigned to benzene represent merely different aspects or phases of the same molecule, which they would not attempt to isolate.

The examples cited by van Laar were, however, selected from a different range of compounds, namely, those in which a mobile hydrogen atom can occupy two alternative positions in the molecule. Their interconversion—which is now usually described as *prototropy*—instead of involving a mere shifting of bonds or wandering of valency

electrons, calls for the displacement of a much more substantial atomic nucleus, and, although this nucleus is only a proton, it has not the same mobility as an electron. Almost as soon as van Laar's theory was announced, therefore, it was proved to be wrong by the isolation as independent chemical compounds of products which he postulated to be identical, but which in fact were entirely different in their physical, and even in some of their chemical, properties. Laar's own theory of tautomerism therefore died in infancy, even if it was not actually still-born; but, since the name which he invented has survived to form the subject of the present monograph half a century later, one may well ask how this has been achieved.

The answer is in some respects a simple one. The pairs of prototropic compounds, which Laar cited as examples of tautomerism, differ as widely as any other isomers in physical properties, such as colour, solubility, melting point, etc., and are distinguished from other isomers only in their ready interconversion. In particular, compounds of this type usually revert to an equilibrium mixture in presence of a mere trace of acid or alkali. They therefore give identical chemical reactions, except under special conditions, for example, in presence of a chemical reagent which has no strong catalytic properties or may even act as an anti-catalyst. At the meeting of the British Association in Oxford, the Chemical Section, under the presidency of Prof. J. F. Thorpe, recognised this point of view by adopting more or less unanimously the definition of tautomerism in the "Oxford Dictionary". This Oxford definition describes the phenomenon of tautomerism as follows:—"This term is applied to the property exhibited by certain compounds of behaving in different reactions as if they possessed two or more different constitutions; that is, as if the atoms of the same compound or group were arranged in two or more different ways, expressible by different structural formulæ."

This anonymous definition is purely chemical in character, since it is based exclusively upon the dual reactivity of a tautomeric compound, and is independent of the possibility of isolating the two 'phases' or 'forms' from which the two types of product are derived. This aspect is indeed so important that it is probable that no better selection could be made of a characteristic on which to base a *re*definition of the term in question. Others have, however, been attempted, since Kurt Meyer in 1913, and Schmidt in 1926, have proposed to limit the phenomenon to cases of prototropy, by insisting that the two sets of derivatives must be derived from two parent substances, which *differ from one another only in the position of a hydrogen atom and of one or more double bonds*. On the other hand, the author of the present monograph wishes to widen the term to include all examples of interconvertible isomers, and is bold enough to claim "universal acceptance" for the view that "*tautomerism is to be regarded as reversible isomeric change.*"

The phenomenon of 'reversible isomeric change', which the reviewer has described as '*dynamic isomerism*', was discovered eight years before the appearance of Laar's paper, by Butlerow, who also recognised that it might proceed either with or without an added catalyst. His observations provide a valid explanation of the dual reactivity which Laar explained by an untenable theory; but chemists in general have never accepted the conclusion that Laar's term should be made to cover the whole range of the phenomenon discovered by Butlerow, and in practice there are many well-established cases of equilibrium between isomers which are generally excluded from the most inclusive of working definitions of tautomerism. Thus even the author of this monograph, in spite of his all-embracing definition, has nothing to say about isomeric changes in the benzene series, such as the conversion of hydrazobenzene into benzidene, or about the Beckmann change in the oximes, or about the combined bromination and reduction (by bromine and hydrogen bromide) which converts αα′ into αβ-dibromocamphor. General usage is, indeed, opposed to describing as tautomeric any isomers which only become interconvertible under special or drastic conditions, and which under normal conditions give no indications of the dual reactivity on which the Oxford definition is based.

The author's proposal to identify 'tautomerism' with 'dynamic isomerism' is a clear violation of the agreement reached at Oxford; but it has the advantage of enabling him to extend the scope of his book to include many topics which would otherwise have been excluded. Thus, in addition to the keto-enol change in the diketones and the facile isomeric changes which give rise to mutarotation, for example, in nitrocamphor and in the reducing sugars, he has been able to include as examples of the "three carbon system" some modern variants of Butlerow's interconversion of olefines, and to discuss a series of isomeric changes in the terpene series, where the conditions are equally severe. The book therefore provides a valuable guide to the widespread researches which have developed from J. F. Thorpe's work on glutaconic acid, as well as to much of the earlier and contemporary work on related subjects.

A theoretical basis for these researches is

provided in an early chapter on the "Modern Theory of Tautomeric Change" and by reprinting in an appendix a paper by Prof. C. K. Ingold on the "Significance of Tautomerism and of the Reactions of Organic Compounds in the Electronic Theory of Organic Reactions"; and the formulæ used in the text are accompanied by the curved arrows by which the theories in question are commonly expressed. On the other hand, it may well be asked whether the author really believes in the 'bridge-bond', stretched to twice the normal length of a carbon-to-carbon bond, which he has included in one of his formulæ for anthracene (p. 275), in defiance of the physical evidence as to the intolerable strain which such an extension must impose.

The book is produced in an attractive form, with adequate subject and author indexes, and should have a wide circulation among chemists.

T. M. L.

## Electron Physics

*Einführung in die Elektronik: die Experimentalphysik des freien Elektrons im Lichte der klassischen Theorie und der Wellenmechanik.* Von Dr. Otto Klemperer. Pp. xii+303. (Berlin: Julius Springer, 1933.) 19.80 gold marks.

PHYSICISTS have long felt the need of a book on electronic phenomena, in which experimental methods and results are collected together in a convenient form for reference. Dr. Klemperer has collected and sifted his material with great care and discrimination. As a handbook for workers with electrons, his book will be an invaluable help. A great number of useful tables and graphs are scattered throughout the work. On p. 12 we have a list of the formulæ, relationships and numerical values of the velocity and energy expressions for the electron; this is followed by a table, constructed from one given earlier by M. G. Fournier, containing numerical data for electrons of all velocities, and the curvature of their paths in different uniform magnetic fields. From the last value given we see that if an electron moves very little less slowly than light, namely in the ratio 0·99999999870 to 1 (corresponding to a volt-velocity of $10^{10}$), the mass increases to 19,585 its rest value.

Details are given for obtaining electron beams of different kinds. The varying types of information given by a Wilson cloud-chamber, and an ionisation chamber, a point counter and a Geiger-Müller tubular counter are clearly contrasted. There is a very useful section on the photographic action of electrons and methods for comparing the intensity of electron beams photographically. An account of electron diffraction is given in Chap. v, which is entitled "The Electron as a Corpuscle and as a Wave". The calculations given in the book are of the simplest kind throughout. A later chapter on the atomic electrons includes a very concise but reasonably complete description of atomic structure and spectroscopic notation (for one and more electron systems). Further subjects dealt with are: photo-electric effect, thermionics, Compton effect, secondary electrons, ionisation in all its forms, interactions between free electrons and atoms, energy losses in collision, absorption of electrons and effective cross-section of atoms and molecules.

The author discloses an intimate knowledge of these different fields and gives more than a thousand references to original papers. There appear to be but few errors. We note one in the small table at the top of page 3, and on page 150, Fig. 97 for the results of Davis and Goucher's experiment is drawn too symmetrically about the $x$-axis. The author deserves the thanks of all colleagues who are experimenting with electrons, whether fast or slow, and also of those who wish to have a complete summary of electronics for quick reference.

H. L. B.

## Dialectical Materialism

(1) *Aspects of Dialectical Materialism.* By H. Levy, Ralph Fox, J. D. Bernal, John Macmurray, R. Page Arnot, E. F. Carritt. Pp. vi+154. (London: Watts and Co., 1934.) 5*s.* net.

(2) *The Web of Thought and Action.* By H. Levy. (The Library of Science and Culture.) Pp. vii+238. (London: Watts and Co., 1934.) 7*s.* 6*d.* net.

(1) "THESE essays have arisen . . . in response to an urgent demand . . . that the philosophy guiding the practice of Modern Russia might be expounded in a form intelligible to the layman." A praiseworthy object indeed, since it is of the first importance that dialectical materialism should be lucidly expounded; then it will be possible to discuss the issues involved in the new philosophy; but few readers will get much enlightenment from this volume.

Out of the six essays, the fifth, by Mr. Bernal, alone attempts any general exposition. It is written in a tone of strident dogmatism, take-or-leave-it style. The exposition is anything but lucid; that this is not merely the judgment of a biased bourgeois reader may be gathered from the concluding essay by Mr. Carritt. The latter, who thinks that Marx would have found him a "hopeful convert", enumerates fifteen doctrines which he regards as "common to Mr. Bernal and

himself". Then he goes on to explain his disagreements with Mr. Bernal. But we need not bother about these disagreements because there are in fact no agreements. Mr. Bernal, who is allowed a postscript, says that "the fifteen articles of Mr. Carritt's cannot be said to be dialectical materialism, or even a part of dialectical materialism". He goes on to rub this in in a fashion that cannot be regarded as complimentary to the Oxford philosopher. So the inquiring reader is likely to rise up from a perusal of the book somewhat bewildered.

The four preceding essayists are more concerned with telling us about the impression made upon them by the new philosophy than by expounding it. To Prof. Macmurray, dialectical materialism is "a revolution in the conception of philosophy itself". It attracts him because "it is the one system of philosophy that recognizes the relation which necessarily exists between any philosophy whatever and the social conditions from which it arises". If this is a revolution or a revelation to philosophers, it is scarcely so to ordinary people; third-rate novelists a hundred years ago recognised that a man's philosophy was conditioned by his social status and tradition. For the rest, Prof. Macmurray is critical. Thus there is no agreement about fundamentals between the contributors; what they do share is a dislike of "capitalism". "Capitalism must strive towards high prices and scarcity," says Prof. Levy; and that of course reminds us of those recent and very successful capitalistic enterprises, Woolworths and Marks and Spencer.

Prof. Levy is the author not only of the first essay in this volume but also of the other book under review (2). The latter takes the form of conversations with "Mr. Everyman", an engineer, a politician (Sir Herbert Samuel) and others. Each conversation is followed by comments. This form of literature seems to be getting popular, but to some readers it is tedious. These conversations lack the interest of vivid reality in spite of the effort to impart it by a familiar and jocular tone; to be attractive they demand unusual imagination and literary skill, which are lacking here.

We are gradually led to the view that politics and history must be studied as sciences. But many workers in these fields would reject this view and would maintain that our difficulties largely arise from the misapplication of the methods of the natural sciences to social studies. The historian and the sociologist do not participate in these discussions. The "social historian" in these conversations is understood to have written a school textbook of physics, and his qualifications for expounding social studies are not apparent.

S.

## Problems of Crossing-Over

*Handbuch der Vererbungswissenschaft.* Herausgegeben von E. Baur und M. Hartmann. Lieferung 19 (Band 1): *Faktorenkoppelung und Faktorenaustausch.* Von Curt Stern. Pp. vii+331. (Berlin: Gebrüder Borntraeger, 1933.) 54 gold marks.

THE physical basis of crossing-over is now one of the major problems in genetics. Its solution will require a more detailed correlation of genetical results with the behaviour of the pairing threads in meiosis than has yet been made. The very extensive genetical facts already accumulated, and set forth at length in the book before us, call for a cytological explanation; but it is safe to say that all the theories hitherto put forward are defective either in supporting observations or in interpretation or in both. Yet it appears that the problem has now reached a point where it can only be solved by the cytologists, with such further aid as genetics can give.

This most intricate problem of cytogenetics clearly involves a fuller understanding of the structure and division of chromosomes and the relations of mitosis to meiosis, as well as the precise behaviour of the leptotene and zygotene threads. The structure and division, as well as the behaviour of these threads, and the nature of the gene itself, are no less concerned in the solution of this problem. It may be expected that much of cytology in the next decade will centre about these questions. New methods of attack will have to be devised and new points of view developed.

In the present work by Prof. Stern, the abundant facts and theories of linkage and crossing-over are set forth *in extenso*. While *Drosophila* supplies the largest single body of data, yet evidence of equal importance is furnished by many other plant and animal organisms, including *Zea*, *Lathyrus*, *Primula*, *Oenothera*, *Pisum*, *Apotettix*, and others. Such phenomena as coincidence and interference in crossing-over and the linkage problems of three or more factors are discussed both theoretically and on the basis of the known results. In the cytological aspect the views of Janssens, Belling, Darlington, Sax and others regarding the rôle of chiasmata are considered. A short final section on interchromosomal linkage is devoted mainly to experimental cases in maize and *Drosophila*, with brief references to the well-known conditions encountered in *Datura* and *Oenothera*.

This book, which has involved the author in much labour, will serve as a very useful storehouse of facts and a clearly arranged work of reference for future investigators.

R. R. G.

## Short Notices

*Crystals and the Polarising Microscope: a Handbook for Chemists and Others.* By Dr. N. H. Hartshorne and A. Stuart. Pp. viii+272. (London: Edward Arnold and Co., 1934.) 16*s.* net.

SECTIONS 1 and 2 of this book deal with crystal morphology. The information included in the fifty pages is surprisingly complete. It is to be regretted, therefore, that the authors have not made use of the stereographic projection (space could have been found by deleting the recapitulations on pp. 50 and 92). The use of etch-figures in, say, distinguishing between ortho- and clino-pinacoids and these in turn from prisms, might have added to the completeness of this portion of the book. The text is liberally illustrated with clear diagrams. (In Fig. 31, $1\bar{1}1$ should read $1\bar{1}0$ and on p. 44, lines 6, 7 and 11 from top should be . . . 2{100} . . . . 4{101} and . . . 6{10$\bar{1}$1}).

It is difficult to refer to the optical treatment (Sections 3–6) without enthusiasm. The ground covered would not be amiss in a volume of twice the size, and descriptions are throughout clear and concise. The drawings, hereabouts, serve their purpose well, those of interference brushes, viewed through differently orientated sections, being particularly useful. Some confusion may result from the authors' description of the mica plate. It is the practice in Great Britain for quartz, mica and gypsum plates to be cut with the longer edge parallel to the $\varepsilon$ or $\gamma$ axis of the ellipsoid (Miers, Tutton, etc.). In Sections 7 and 8, the authors make out a good case for the increased use of the polarisation microscope in industry and research.

The printing is clear, and authors and publishers are to be congratulated on a book, useful alike to research physicists, geologists and crystallographers, as well as to chemists. H. E. B.

*Sexual Life in Ancient Rome.* By Otto Kiefer. Translated from "Kulturgeschichte Roms unter besonderer Berücksichtigung der Römischen Sitten" by Gilbert and Helen Highet. Pp. ix+379+16 plates. (London: George Routledge and Sons, Ltd., 1934.) 25*s.* net.

IN matters relating to sex, the ancient Romans displayed the practical qualities which they brought to bear on all the problems of their lives, both public and private. It affected their attitude generally to all forms of erotic emotion, as well as in the relation of the sexes. For it has to be remembered that the ancient Romans, if not universally, very commonly, were indifferently homo- and heterosexual, and accepted that as a matter of course. Dr. Kiefer, in the work of which this is a translation, has explored the records of the reactions of the Roman world in marriage, in religion, in literature and in art, and finds not only that there is little of the spiritualisation of this emotion such as existed among many of the Greeks, but also that there is in it no little of a sadistic element. He is, however, by no means a supporter of the view which would ascribe the downfall of the Empire to decadent mores in relation to sex. An acute analysis of the sexual element in the character of certain of the early emperors and members of their entourage, discounts the scandals of their biographers in some, but not all, instances.

*Satellite Station Tables.* By C. M. L. Scott. Pp. vii+44. (London: Edward Arnold and Co., 1934.) 12*s.* 6*d.* net.

IT sometimes happens in minor triangulation that well-marked objects, which are otherwise suitable as trigonometrical points, cannot be observed from, though they are well placed for 'observing to'. Burma, with its innumerable pagodas, offers thousands of examples of this, and it is not surprising that the book under review should have been written by the port surveyor at Rangoon. These tables will save labour in cases in which there is much satellite-station work, though in ordinary minor triangulation, in which satellite stations are usually avoided, or are but rarely used, the surveyor may prefer to make his corrections by the application of elementary trigonometry.

The tables have been carefully prepared and are well set out and printed. They are suitable for the purpose intended, which is, briefly, to reduce the angles taken at a satellite station to the values which they would have had if they had been observed at the inaccessible station itself. The corrections are given to the nearest second, an accuracy more than sufficient for this class of work. The book can be recommended to those who find themselves obliged to use satellite stations frequently. The tables can, as remarked in the foreword, be made use of for tacheometrical calculations.

*Introduction to Modern Physics.* By Prof. F. K. Richtmyer. (International Series in Physics.) Second edition. Pp. xviii+747+6 plates. (New York and London: McGraw-Hill Book Co., Inc., 1934.) 30*s.* net.

THE first edition of Prof. Richtmyer's book has been appreciated by so many physicists that the appearance of a second edition is bound to be warmly welcomed, and it is only necessary here to note the chief changes which have been made. An adequate outline of the application of Fermi-Dirac statistics to problems in photo-electricity has been added and the chapter on X-rays brought up to date. The chapter on the structure of the nucleus has been considerably altered in view of recent work on artificial disintegration, and the neutron and positron both find a place, though perhaps a small one in the case of the latter. Two very important new chapters have been included, one on the vector model of the atom and one on the wave theory of matter. The first will be particularly helpful to students, and the latter properly completes a first-class introduction to modern physics.